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4.1 DESIGN EXCELLENCE

To achieve design excellence, one should be:

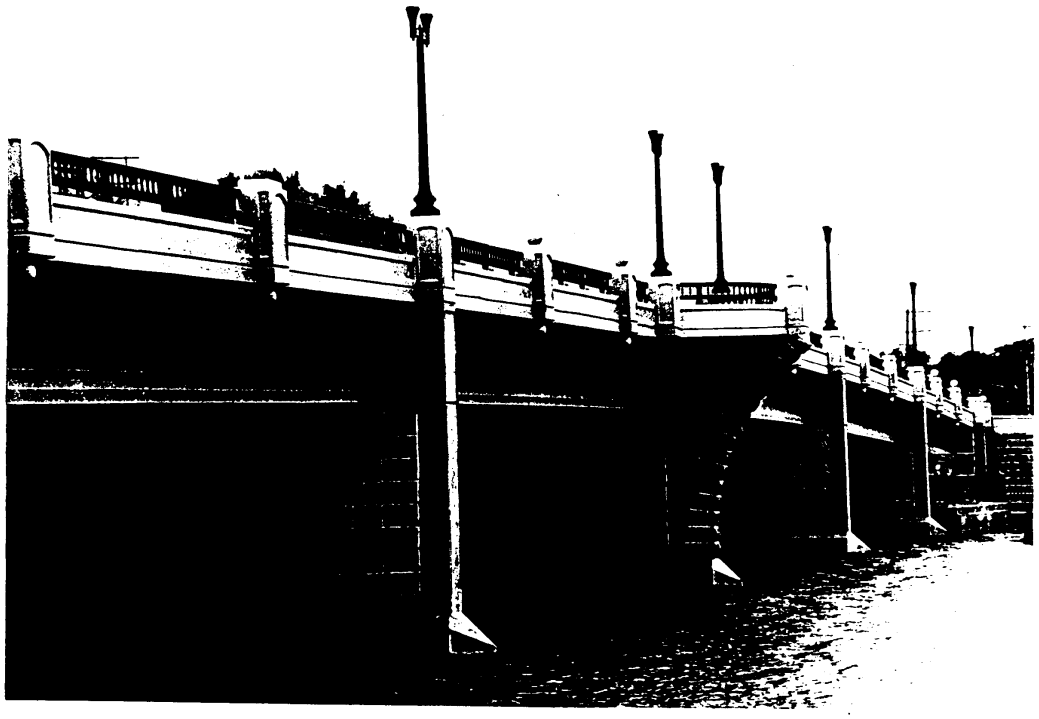
A. Creative and aesthetic
B. Analytical
C. Technical and practical

Science, technology, art and economy are the prerequisites for design excellence. Where one or more of these aspects is flawed or not fully considered during design, the final design will probably be flawed, in some cases with distressing results.

The Tacoma Narrows Bridge is an example of technology and art without sufficient science on wind dynamics, which caused the bridge to collapse.

A Rib-Arch Bridge in Ohio was built with science and art but without technology. Numerous deck joints, poor concrete and deicing salts deteriorated the spandrel columns beyond repair, thus causing the bridge to be demolished.

There are many examples of bridges built with science and technology but without art. Just look around.



4.2 AESTHETIC GUIDELINES

Primary Features	Secondary Features
1. Superstructure Type and Shape	1. Railing
2. Abutment Type and Shape	2. Architectural Etchings
3. Pier Type and Shape	3. Color
4. Lines and Grades	

Consider the following guidelines when designing structures:

A. Clear Structural System
B. Good Proportions in 3 Dimensions
C. Good Order - Lines & Edges
D. Integration into the Environment/Landscape
E. Choice of Materials
F. Coloring - Soft Colors (Chapter 9 for Approved Colors)
G. Lighting
H. Simplicity of Shape
I. Recognizable Flow of Forces

Consider the bridge shape, relative to the form and function at the location. Use a structural shape that blends with its surroundings. The aesthetic impact is the effect made on the viewer by every aspect of a bridge in its totality and in its individual parts. The designer makes an aesthetic decision as well as a structural decision when sizing a girder or locating a pier.

The structure lines should be flowing and simple. Do not clutter up the structure with distractive elements. If light standards are required, place them in line with the piers, so the vertical lines blend. Keep girder stiffeners on the outside face of exterior girders at abutments and piers only. If pedestrian fencing is required, consider cathedral post shapes, or a shape that blends.

Consider focal points on the structure to attract the viewer such that other features are less noticeable. This can be achieved with shadow lines. Consider concrete stains to create color lines or patterns to attract the viewer. Stains tend to penetrate and are more durable than paints and surface finishes.

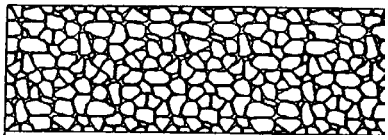
Formliners are an inexpensive way to provide features of relief in concrete. They have been used on concrete walls or parapets to depict historic scenes or artistic designs. They break up the solid, blank wall appearance. Formliners have also been used to provide aesthetic form to abutments and piers. Form details should be terminated 1’-0” (300 mm) below low water or ground elevations where they will not be visible. Formliners are relatively inexpensive if they can be reused. The designer should detail the required structural shapes and then allow the contractor some flexibility to adjust

the size to accommodate form liners. An extra 5 cubic yards (4 cubic meters) of concrete can offset the cost of wasting formliner if they need to be cut. Form liners are not reusable if they must be cut, so right angle shapes work best. Where there are sloping lines, provide an optional construction joint allowing the contractor to extend the formliner above the slope. The following standard patterns should be detailed on structures such that contractors can reuse their forms.

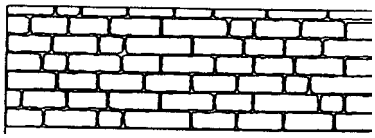
Variations of the pattern should be accepted on projects in order to promote competition from suppliers.

Acceptable Formliner Patterns

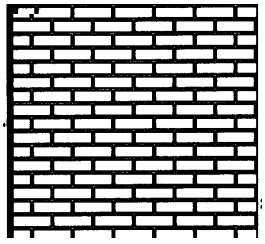
A. Fieldstone – Random – Duplicates color & texture of natural stones with sizes between 6 & 24".



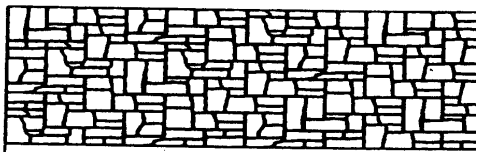
B. Rectangular Cut Stone – Duplicates cut stone with variable sizes and spacing. (Specify course height with ± 4" maximum allowance).



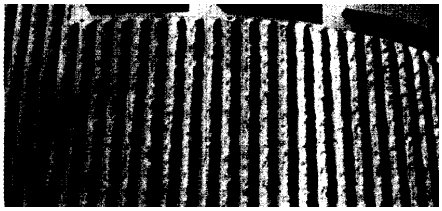
C. Rectangular Brick – Simulates a standard brick wall.



D. Rustic Ashlar – Variable height and width stone between 8” and 32” in size.



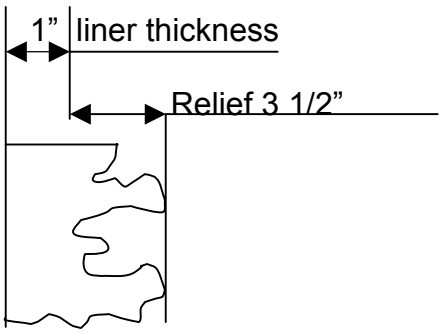
E. Broken Rib – Simulates fluted or trapezoidal vertical rib patterns. Width and depth of rib is 2” ± 1/2”.



There are some situations where single use form liners may be more economical than reusable liners. This should be discussed with the suppliers if there are some questions. It is better to allow the contractor flexibility to choose the best formliner material.

Look at nature for examples of proportions of elements such as trees, etc. The span to depth ratio of the structure should be proportional. The number and spacing of piers should be proportional to the height unless there are other features to avoid. Pier shapes should also be proportional. Hammerhead piers need adequate column heights as an example.

| Formliners are usually 1 to 1 1/8 inches thick and relief is usually 3 or 3 1/2 inches
| although some are 5” deep. Assume 1-inch thick liners and 3 1/2” relief when
| designing and detailing. Add only relief when dimensioning plans.



4.3 LEVELS OF AESTHETICS

The Regional Office should establish one of the following levels of aesthetics and indicate it on the Structure Survey Report. This will help the structures designer decide what level of effort and possible types of aesthetics treatments to consider. If Level 2 or greater is indicated, the Regional Office personnel needs to suggest any particular requirements such as railing type, pier shape, special form liners, color, etc. in the comments area of the Structure Survey Report. Specify on the Structure Survey Report whether anti-graffiti coating is required. Areas normally requiring the coating are readily accessible to people with moderate to low levels of activity. High traffic areas or areas with continuous activity would not be as vulnerable to graffiti.

The preliminary plan should incorporate all the agreed upon aesthetic treatments so that final design can proceed efficiently. These details would be developed mutually between the preliminary bridge designer and the Regional Office.

(1) Level One: A general structure designed with standard structure details. This would apply in rural areas and urban areas with industrial development.

(2) Level Two: Consists of cosmetic improvements to conventional Department structure types, such as the use of color stains/paints, texturing surfaces, modifications to facia walls and beams or more pleasing shapes for columns. This would apply where there needs to be less visual impact from roadway structures.

(3) Level Three: Emphasize full integration of efficiency, economy and elegance in structure components and the structure as a whole. Consider structure systems that are pleasing such as shaped piers, integral caps and smooth superstructure lines. These structures would need to harmonize with the surrounding buildings and/or the existing landscape.

(4) Level Four: Provide overall aesthetics at the site with the structure incorporating level three requirements. The structure would need to blend with the surrounding terrain and landscaping treatment would be required for the total appearance.

4.4 EXAMPLES

California uses integral pier caps on their structures. They use formliners to provide texture on their piers and concrete parapets. They also use concrete stain to produce shadow lines or racing stripes on the superstructure. Concrete ribs should be 2" wide to prevent spalling during form removal.

California used formliners and stain to produce artistic geometry on a long retaining wall. Minnesota also did this on the noise walls on the Wabasha Bridge. WISDOT used stain and geometry on a retaining wall for the Tri County Expressway.

On haunched concrete girders the haunch was placed in the shadow so the superstructure appeared to have straight horizontal lines. On a box girder, the bottom slab was thickened inside the box at the pier so the girders appeared straight.

Integrate landscaping into the structure. Use shrubs to enhance the appearance at critical areas.

Texas used formliners to create shadow panels on a bridge railing to simulate an old shape that the community wanted to preserve.

If traffic signs are mounted on the bridge, keep the sign height within the silhouette of the bridge.

Use side walls or pier extensions to cover bearings.

Ohio uses paving brick for slope paving at some sites. They also use planters for certain locations.

Several states use formliners to replicate stone faced piers or abutments.

Washington used shotcrete on a large retaining wall and shoved roots and branches along with dirt into it to get a natural look.

REFERENCES

1. "Bridge Aesthetics Around the World", Transportation Research Board, Washington, D.C., 1991.

2. “Esthetics in Concrete Bridge Design", American Concrete Institute, Detroit, Michigan, 1990.

3. “Aesthetic Guidelines for Bridge Design”, Minnesota Dept. of Transportation, 1995.